

Atrial Pacing During Selective Coronary Angiography*

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One of the effects of injecting radiocontrast material into the coronary circulations (Sones and Shirey, 1962) is a fall in heart rate due to sinus slowing (Benchimol and McNally, 1966; MacAlpin *et al.*, 1966; Guzman and West, 1959). This bradycardia begins within a few beats of injection, quickly reaches a peak, and subsides in less than a minute. Though brief and transient, it is often quite dramatic (Fig. 1 and 2). Its cause is not known, but is more probably ischæmia of the sinus node than vagotonia, for it more often follows right than left coronary injection‡, and is not, as a rule, associated with depression of atrio-ventricular conduction. Its importance is its relation to several undesirable phenomena which are in part due to it.

The first of these phenomena is a decrease in coronary and aortic pressure which, though in most instances of little importance, is appreciable in a significant number of cases: it exceeded 40 per cent of pre-injection levels in over 30 per cent of 29 cases in which we recently carried out hæmodynamic measurements during selective coronary arteriography (Benchimol and McNally, 1966). The pressure decrease proceeds *pari passu* with the bradycardia and parallels it roughly in degree, and is largely the direct result of the slowing, for it is almost completely abolished by pacing the heart at its pre-injection rate throughout this period (Fig. 2).

Though we have measured neither coronary nor systemic flows during this period, we believe that the fall in perfusing pressures is associated with a decrease in perfusion itself, that is, in coronary and systemic flow. That this is so is suggested by the

concurrence of certain subjective phenomena. The first of these is a sense of dissolution or of "falling out" which must be due principally to either the hypotension, the bradycardia, or both, since it, too, is virtually abolished by pacing. The second of the subjective phenomena associated with the bradycardia is angina: if a patient is to experience angina during selective coronary arteriography, it usually begins at the height of the slowing. Angina is less clearly and regularly affected by pacing than the other phenomena, but we have the distinct impression that preventing the bradycardia lowers its incidence and lessens its severity and duration.

The bradycardia and its attendant hæmodynamic phenomena occur at a time when the myocardium has been made ischæmic by the displacement of blood from the coronary tree by the contrast material, and when ventricular repolarization, as manifested by marked ST- and T- changes, is at its most abnormal (Benchimol and McNally, 1966) (Fig. 1 and 2).

These events all combine, we feel, to render the heart particularly susceptible during this period to ventricular arrhythmias. While the myocardium is ischæmic and the coronary tree filled with high viscosity contrast material, coronary perfusion pressure falls. Concurrently, the patient experiences subjective sensations which are certainly associated with a considerable sympathetic discharge. In this setting, and in the presence of deranged repolarization, periods of virtual asystole may occur, a circumstance favouring the "unmasking" or "release" of any potential ectopic foci that may be present.

Although we have not yet encountered complications directly traceable to this combination of phenomena, we have had many a harrowing moment during this first minute after injection (Fig. 1), especially when, at the height of the bradycardia, escape beats of aberrant contour and bizarre pre-matures have appeared.

Preventing the bradycardia by pacing will not, of course, obviate all the factors that combine to make

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‡ The sinus node artery arises about twice as often from the right as from the left coronary artery (James, 1965).

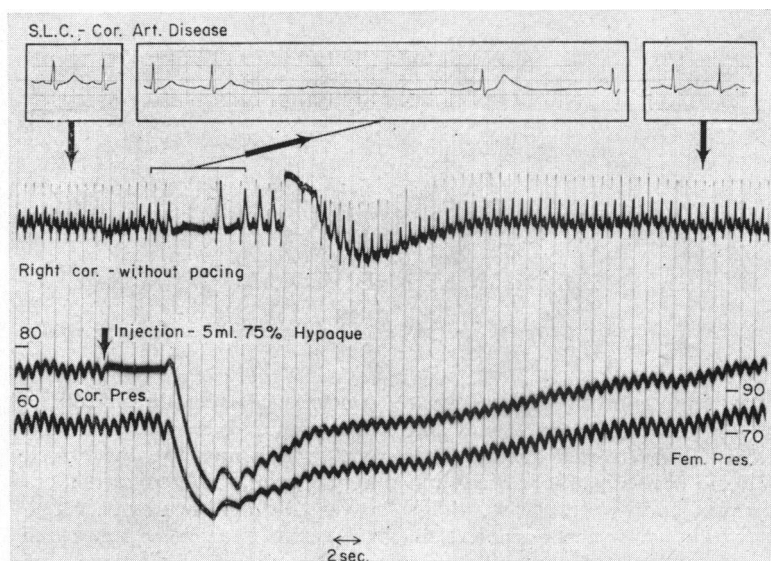


FIG. 1.—Lead II of electrocardiogram and mean coronary and femoral artery pressures before, during, and after injection of 5 ml. 75 per cent Hypaque into the right coronary artery. The electrocardiogram (lead II) on the top of the panel was taken with standard electrocardiograph at a paper speed of 25 mm./sec. Note sinus slowing for a period of 4 seconds accompanied by a fall in the mean coronary and femoral artery pressures. Observe a slow return of these pressures to the control levels. Time lines—1 sec.

this period a dangerous one, but we feel that it can lower the risk enough to justify its routine use during coronary arteriography. For this reason it has become our practice to pace the heart during injection and for the first minute or so thereafter. The

rate we chose is one just fast enough to assure continuous capture, that is, one slightly faster than the spontaneous pre-injection rate. We employ the right atrium rather than the right ventricle as the pacing site for two reasons. First, when the pacing

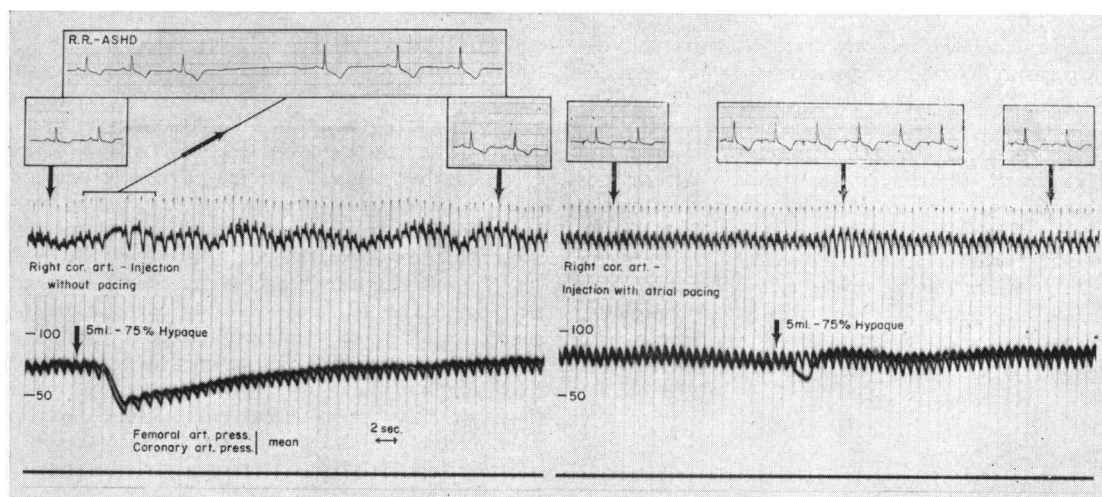


FIG. 2.—Lead II of the electrocardiogram and mean coronary and femoral artery pressures before, during, and after injection of 5 ml. 75 per cent Hypaque into the right coronary artery. The tracings on the left were taken without atrial pacing, and the one on the right during atrial pacing. Note sinus slowing and fall in pressures during injection without atrial pacing. These changes were abolished when the right atrium was paced.

catheter is located in the atrium, it does not interfere with visualization of the coronary tree; when it is in the right ventricle, it usually does. Second, the pacemaker is less likely to precipitate an arrhythmia in the atrium than in the ventricle. Furthermore, pacing the atrium poses no problem. Atrio-ventricular conduction is rarely affected by coronary injection, and we have had no difficulty in achieving consistent capture. It is, moreover, safe: in the course of various physiological studies we have paced the atria of more than 100 patients, and have encountered no ill effects, immediate or delayed, in any (Benchimol *et al.*, 1965b; Benchimol, Ellis, and Dimond, 1965a). Inserting the pacemaker catheter adds negligibly to the procedure, since a cutdown must in any event be made upon the brachial artery. Finally, a "dividend" of having a catheter in the right heart is that it provides a more favourable site than the aorta for injecting medication should the need arise.

SUMMARY

The minute which follows selective injection of radiocontrast medium into the coronary circulation is one of high risk of major arrhythmias because of a combination of phenomena, several of which are directly due to the bradycardia which follows injection. The latter effects can be abolished by pacing

the heart throughout this period, and the risk of arrhythmia thus appreciably reduced. We have, therefore, adopted pacing as a routine practice during selective coronary angiography. For several reasons, we employ the right atrium rather than the right ventricle as the pacing site.

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